



GUIDELINES FOR ESTIMATING CROPS AND PRODUCE IN STORAGE

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Taking inventory involves physically counting, estimating and valuing inventory items. Of these tasks, estimating the quantity of inventory is often the most difficult -- particularly for farmers with crops or produce. This publication illustrates some formulas which can be used to make this task easier.

Volume of Grain in Bins and Piles -- Metric Measurement

To determine the volume of grain in a rectangular bin or truck box, measure the length, width and average height of the grain pile in metres. Multiply these three numbers as shown below to get the volume in cubic metres (m^3).

Volume of grain in a
rectangular bin (m^3) = length (m) x width (m) x average height (m)

To determine the volume of grain in a cylindrical bin, determine the area of the floor in square metres (m^2) by multiplying the diameter (m) x diameter (m) x 0.785. Then multiply this floor area times the average height of grain (m). The following formulas illustrate this calculation.

Bin floor area (m^2) = diameter (m) x diameter (m) x 0.785

Volume of grain in a
cylindrical bin (m^3) = floor area (m^2) x average height (m)

To determine the volume of grain in a **triangular pile**, measure the length, width and height of the pile in metres. Multiply the length by the width by the height. Then multiply the result by a factor of $1/2$.

Volume of grain

in a triangle (m^3) = length (m) x width (m) x height (m) x $1/2$

To determine the volume of grain in a **cone**, calculate the area of the base as shown above for a cylindrical bin. Then multiply the area by $1/3$ and by the height of the pile in metres as shown below.

Volume of grain

in a cone (m^3) = floor area (m^2) x $1/3$ x height (m)

Weight of Grain in Bins and Piles -- Metric Measurement

To convert the volume of grain to weight in tonnes, multiply the average bulk density of the grain in tonnes per cubic metre by the volume of the grain in cubic metres. Approximate average bulk densities for various crops as shown below.

Approximate Average Bulk Densities

Wheat, peas, beans, clover	0.770 t/m ³
Rye	0.730 t/m ³
Corn	0.700 t/m ³
Flax	0.650 t/m ³
Canola, Mustard	0.640 t/m ³
Barley	0.620 t/m ³
Buckwheat	0.610 t/m ³
Oats	0.470 t/m ³
Sunflower Seed	0.290 t/m ³

Weight

of Grain (t) = volume of grain (m^3) x average bulk density (t/m³)

Example:

To determine the volume and weight of wheat in a cylindrical bin -- 5.8 metres in diameter and with an average depth of 4 metres, take the following steps:

$$\begin{aligned}\text{Floor area} &= \text{diameter} \times \text{diameter} \times 0.785 \\ &= 5.8 \times 5.8 \times 0.785 = 26.4 \text{ m}^2\end{aligned}$$

$$\begin{aligned}\text{Volume of grain} &= \text{floor area} \times \text{average height} \\ &= 26.4 \times 4 = 105.6 \text{ m}^3\end{aligned}$$

$$\begin{aligned}\text{Weight of grain} &= \text{volume of grain} \times \text{average bulk density} \\ &= 105.6 \text{ m}^3 \times 0.770 \text{ t/m}^3 = 81.31 \text{ t}\end{aligned}$$

Weight of Grain in Bins and Piles -- Imperial Measurements

To determine the volume of grain in bins or pile using imperial measurement, you utilize the same formulas discussed in the metric section substituting imperial for metric measurements. Specifically, the formulas for volume of grain are as follows:

Rectangular bin or truck box:

Volume

$$\text{of grain (ft}^3\text{)} = \text{length (ft)} \times \text{width (ft)} \times \text{average height (ft)}$$

Cylindrical bin:

$$\text{Bin floor area (ft}^2\text{)} = \text{diameter (ft)} \times \text{diameter (ft)} \times 0.785$$

$$\text{Volume of grain (ft}^3\text{)} = \text{floor area (ft}^2\text{)} \times \text{average height (ft)}$$

Triangular pile:

$$\text{Volume of grain (ft}^3\text{)} = \text{length (ft)} \times \text{width (ft)} \times \text{height (ft)} \times 1/2$$

Cone:

$$\text{Volume of grain (ft}^3\text{)} = \text{floor area (ft}^2\text{)} \times 1/3 \times \text{height (ft)}$$

To convert a volume of grain expressed in cubic feet into volume bushels, you simply multiply the volume of grain in cubic feet by a factor of 0.7786. This formula is expressed below.

$$\text{Volume bushels of grain} = \text{Volume of grain (ft}^3\text{)} \times 0.7786$$

Example:

Let's consider the previous example in imperial measurements. To determine the volume bushels of wheat in a cylindrical bin -- 19.02 feet in diameter and with an average depth of 13.12 feet, take the following steps:

$$\begin{aligned}\text{Floor area} &= \text{diameter} \times \text{diameter} \times 0.785 \\ &= 19.02 \times 19.02 \times 0.785 = 283.98 \text{ ft}^2\end{aligned}$$

$$\begin{aligned}\text{Volume of grain} &= \text{floor area} \times \text{average height} \\ &= 283.98 \times 13.12 = 3725.82 \text{ ft}^3\end{aligned}$$

$$\begin{aligned}\text{Volume bushels} \\ \text{of grain} &= \text{volume of grain} \times 0.7786 \\ &= 2900.92 \text{ volume bushels}\end{aligned}$$

To determine the weight bushels, you need to know the bulk density of the grain (bushel weight). Multiply the volume bushels by the ratio of the actual bushel weight to the standard bushel weight.

$$\begin{aligned}\text{Weight bushels} \\ \text{of grain} &= \text{volume bushels of grain} \times \frac{\text{actual bushel weight}}{\text{standard bushel weight}}\end{aligned}$$

If the actual bushel weight is 62 lb/bu in our previous example, you would find the weight bushels as follows:

$$\begin{aligned}\text{Weight bushels} \\ \text{of grain} &= 2900.92 \text{ volume bu} \times \frac{62 \text{ lb/bu}}{60 \text{ lb/bu}} = 2997.62\end{aligned}$$

Conversions of bushels of grain to tonnes and vice versa can be found using the following table:

**Conversion of Bushels to Tonnes
and Tonnes to Bushels**

Crop	Tonnes/Bushel	Bushels/Tonne
Wheat	0.0272	36.744
Oats	0.0154	64.842
Barley	0.0218	45.930
Rye	0.0254	39.368
Canola	0.0227	44.092
Flax	0.0254	39.368
Corn	0.0254	39.368
Sunflowers	0.0136	73.487

Hay or Straw in a Stack

To find the weight of hay or straw in a stack, determine the volume of stack and multiply by the density of the hay or straw. Then, divide the resulting weight by the appropriate conversions -- 1000 kg/t or 2000 lb/ton -- to obtain tonnes or tons respectively.

For metric calculations, volume is expressed in cubic metres (m^3) and density in kg/m^3 . For imperial calculations, volume is expressed in cubic feet and density in lb/ft^3 .

Metric

Kg of hay or straw = volume of stack (m^3) x density (kg/m^3)

Tonnes of hay or straw = $\frac{\text{kg of hay or straw}}{1000 \text{ kg/t}}$

Imperial

lb of hay or straw = volume of stack (ft³) x density (lb/ft³)

Tons of hay or straw = $\frac{\text{lb of hay or straw}}{2000 \text{ lb/ton}}$

Typical densities of hay and straw are as follows:

	Metric	Imperial
Long hay	50 - 75 kg/m ³	3 - 5 lb/ft ³
Long straw	20 - 30 kg/m ³	1 - 2 lb/ft ³
Chopped or shredded hay	65 - 100 kg/m ³	4 - 6 lb/ft ³
Baled hay		
large round balers	50 - 200 kg/m ³	9 - 13 lb/ft ³
small rectangular balers	150 - 200 kg/m ³	9 - 13 lb/ft ³
ground roll balers	80 - 120 kg/m ³	5 - 7.5 lb/ft ³
Baled Straw		
large round balers or		
small rectangular balers	100 - 125 kg/m ³	6 - 8 lb/ft ³

Silage Measures

To determine the actual weight of silage in a silo it is important to know the moisture content. Since the dry matter content is of most interest, it is useful to know the dry matter capacity of a silo. The capacities of various tower silos given below are based on a 12 mm (1/2 in) length of cut. Reducing the length of cut to 6 mm (1/4 in) would increase the capacities by 10% to 15%. If silos are refilled after settling, the capacities are about 10% higher.

Tower Silo Capacities

Nominal Size		Dry Matter Capacities	
Metres	Feet	tonnes	tons
6.1 x 15.2	20 x 50	105	116
6.1 x 18	20 x 59	125	138
6.1 x 20.7	20 x 68	155	171
6.1 x 21.4	20 x 70	160	176
7.3 x 18.3	24 x 60	185	204
7.3 x 22	24 x 72	235	259
7.3 x 25.5	24 x 84	275	303
7.3 x 29	24 x 95	315	347
7.6 x 20	25 x 66	225	248
7.6 x 25.5	25 x 84	305	336
9.2 x 18.3	30 x 60	290	320
9.2 x 21.4	30 x 70	345	380
9.2 x 24.4	30 x 80	410	452
9.5 x 25	31 x 82	500	551
11 x 21	36 x 69	500	551

Silage in horizontal silos that are packed with a tractor normally has a dry matter density of 225 kg/m^3 (14.05 lb/ft^3). To determine the capacity of a bunker silo, multiply the volume of the silo by the dry matter density of the haylage or silage. Then divide the capacity in kilograms or pounds by the appropriate conversion rate (1000 kg/t or 2000 lb/ton) to determine dry matter capacity in tonnes or tons respectively.

Metric Measurement

$$\text{Volume of silo (m}^3\text{)} = \text{length (m)} \times \text{width (m)} \times \text{depth (m)}$$

$$\text{Dry matter capacity (kg)} = \text{volume of silo (m}^3\text{)} \times \text{density (kg/m}^3\text{)}$$

$$\text{Dry matter capacity (t)} = \frac{\text{Dry matter capacity (kg)}}{1000 \text{ kg/t}}$$

Imperial Measurement

$$\text{Volume of silo (ft}^3\text{)} = \text{length (ft)} \times \text{width (ft)} \times \text{depth (ft)}$$

$$\text{Dry matter capacity (lb)} = \text{volume of silo (ft}^3\text{)} \times \text{density (lb/ft}^3\text{)}$$

$$\text{Dry matter capacity (tons)} = \frac{\text{Dry matter capacity (lb)}}{2000 \text{ lb/ton}}$$

Example:

Bunker silo, 10 m x 30 m x 3 m

$$\text{Volume of silo (m}^3\text{)} = 10 \text{ m} \times 30 \text{ m} \times 3 \text{ m} = 900 \text{ m}^3$$

$$\text{Dry matter capacity (kg)} = 900 \text{ m}^3 \times 225 \text{ kg/m}^3 = 202,500 \text{ kg}$$

$$\text{Dry matter capacity (t)} = \frac{202,500 \text{ kg}}{1000 \text{ kg/t}} = 202.5 \text{ t}$$

To determine the actual silage weight, you need to know the moisture content (and consequently dry matter content). For example, if moisture content is 60%, dry matter content is the remaining 40% (equivalent to 0.4 in decimals). To find actual silage weight, divide the dry matter weight or capacity by the dry matter content (in decimals).

$$\text{Actual silage weight (t)} = \frac{\text{Dry matter capacity (t)}}{\text{Dry matter content}}$$

Example:

$$\text{Actual silage weight} = \frac{202.5 \text{ t}}{.4} = 506.25 \text{ t}$$

Conclusion

The methods described provide a structured system for estimating crops and produce in storage. They should assist you in obtaining an accurate assessment of your farm inventories.

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FOR FURTHER INFORMATION SEE YOUR LOCAL MANITOBA AGRICULTURE OFFICE.